Summary Report of BNL Occupational Medicine Clinic (OMC) Medical Surveillance Examination Results for BNL Employees in Fiscal Year 2005 (FY05)

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Executive Summary

This report summarizes OMC's findings from 507 OSHA or DOE-mandated medical surveillance exams performed during Fiscal Year 2005 ("FY05") for BNL employees with potential occupational exposure to asbestos, beryllium, cadmium, lead and noise. Medical Surveillance examinations and clinical tests look for internal doses or early biological effects from these exposures. Results showed:

- **No detectable occupational overexposures or adverse health effects from current or recent exposure to asbestos, cadmium or lead.**
- **One instance of an employee found to be sensitized to beryllium. It is considered unlikely that this employee's beryllium sensitization was the result of beryllium exposures at BNL, since they were minimal and transient, and since the employee had previously worked at a job with potential beryllium exposure. The employee showed no evidence of beryllium-associated lung disease ("Chronic Beryllium Disease").**
- **Just one instance of OSHA-recordable occupational hearing loss (referred to as a "Standard Threshold Shift" or "STS"). This represents a remarkable improvement from Calendar Year 2004 ("CY04") when 7 STS's were observed.**

Taken together, these results show that efforts at protecting BNL employees from workplace health hazards have, to date, been highly successful and continue to improve.

OMC encourages:

- **Continued workplace exposure monitoring, appropriate exposure control measures, and medical surveillance in accordance with applicable OSHA and DOE standards, and best practices.**
- **Further encouraging employees to make safe work practices a "core value" that they bring with them to work and hobbies away from BNL, as well as at BNL.**

Introduction

In FY05, OMC performed 498 OSHA-mandated medical surveillance examinations for BNL employees with potential occupational exposure to the following common workplace hazards: *asbestos, cadmium, lead and noise*. In addition, 9 DOE-mandated beryllium medical surveillance examinations were performed for employees with potential beryllium exposures. (See table in *Results* section below).

This report provides summary results from these exams, as well as a comparison of FY05 results to results reported in OMC's CY04 summary report of Medical Surveillance examination results. Due to a shift in the reporting cycle from the calendar to the fiscal

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year, there is actually a 3 month overlap in the data reported in the earlier and the current reports (October-December 2004).

Medical surveillance is an important component of Integrated Safety Management, in that it provides assurance that the line organizations are adequately protecting their workers from workplace health hazards. Medical surveillance examinations of employees, including clinical testing, assess:

1) The internal dose of workplace substances (e.g.; blood lead and cadmium levels)
2) Early evidence of harm resulting from exposure to workplace hazards (e.g.; hearing loss from loud noise exposure; changes in chest x-ray or pulmonary function tests due to scarring of the lungs or their linings as a result of prior asbestos exposure)

Data generated by medical surveillance examinations provide valuable feedback to line and support organizations on the effectiveness of BNL worker health protection programs directed at protecting BNL workers from overexposure to hazards or deleterious health effects resulting from these hazards.

Confidentiality statement: Because this report includes the results of clinical tests, personal identifiers have been removed, and no information on personal medical conditions is reported, in order to protect worker privacy and confidentiality.

Methods

OMC performs the types of medical surveillance exams included in this report in response to a request for such surveillance communicated to OMC from a line organization through an Additional Medical Surveillance Form (AMS) completed by an employee's supervisor and ES&H Coordinator. Surveillance exams are performed in compliance with OSHA or DOE medical surveillance requirements included in OSHA or DOE standards pertaining to workplace hazard control. Generally, exposure at or above a specified regulatory Action Level for a specified duration triggers a required medical surveillance examination. For instance, medical surveillance under the OSHA Lead General Industry Standard, 29CFR1910.1025, is triggered by exposure to lead at or above the OSHA Action Level of 30 ug/m3 (8 hours time weighted average) for more than 30 days per year.

Components of a medical surveillance exam may include: a focused occupational and health history, a physical examination and appropriate clinical tests, which can include blood tests, urinalysis, chest x-ray, or spirometry (pulmonary function testing), depending upon the exposure and potential organ toxicity. Most of these tests are performed in-

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house at OMC, but blood and urine samples are analyzed at a licensed commercial laboratory; chest x-rays are sent out for interpretation by a Board Certified radiologist.

OMC medical surveillance exams and results are recorded in hard copy OMC medical records and electronically through Occupational Health Manager ("OHM"), a proprietary electronic medical records software package specifically designed for occupational medicine practices. OHM has the capacity to generate individual or summary reports of medical surveillance exams based upon data previously entered. These reports are the basis of the summary report presented here.

Results

The following table summarized medical surveillance exams performed at BNL by OMC in FY05, by department/division and by type of surveillance:

	SURVEILLANCE TYPE						
Department/ Division*	**Asbestos**	**Beryllium**	**Cadmium**	**Lead-Construc-tion**	**Lead-General Industry**	**Noise**	**Totals by Dept./Div**
AD		4			1	60	**65**
AM						1	**1**
DA						1	**1**
DE					1		**1**
DF						2	**2**
EM						29	**29**
EP	6		2	94	3	164	**269**
ES						4	**4**
HP	1			3	1	9	**14**
ID		1				2	**3**
LS		3		5		1	**9**
PO						1	**1**
RP			3		5	26	**34**
SC		1		1	1	18	**21**
SE					5	39	**44**
WM					7	2	**9**
Totals by Surveillance Type	**7**	**9**	**5**	**103**	**24**	**359**	
						Grand Total	**507**

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SPECIFIC SURVEILLANCE PROGRAMS AND RESULTS

Asbestos

Background

The chief organ toxicity from asbestos is the lung. Asbestos exposure via the respiratory route can affect the lung itself or its lining (the pleura). There is a long latency between exposure and disease outcome, generally exceeding 15 years. Asbestos-induced scarring ("fibrosis") of actual lung tissue is referred to as asbestosis. Effects on the pleura, or lung lining, include pleural thickening, pleural plaques (focal areas of thickening) and mesothelioma (malignant pleural tumor). Asbestos exposure has also been associated with increased lung cancer risk, especially in smokers.

Currently, asbestos work at BNL has been determined to fall under the OSHA Asbestos Construction Standard (29CFR1962.1101). This standard requires medical surveillance exams for workers exposed at or above the OSHA time-weighted average (TWA) or excursion limits for airborne asbestos fibers. Clinical testing includes chest x-rays on a schedule recommended by the OSHA standards, and spirometry (pulmonary function testing) to detect any impairment of lung function.

Results: 7 BNL employees received asbestos medical surveillance because of potential asbestos exposure as a result of insulation work, asbestos abatement and monitoring of asbestos work. These workers included 6 EP employees and one industrial hygienist.

- **In 6 workers, there were no findings consistent with asbestos-related lung disease.**
- **The remaining worker had been diagnosed in 1991 with mild asbestosis based upon a chest x-ray, apparently as a result of asbestos exposure in the military in the early 1970's. This worker showed no progression of this pre-existing asbestosis based upon x-ray findings, and has normal lung function.**

Beryllium

Background

Exposure to the metal beryllium, especially through inhalation of fine beryllium particles, can result in allergic-type sensitization in genetically predisposed individuals. Sensitized individuals are at risk of developing chronic beryllium disease (CBD), a condition in which expanding round scars ("granulomas") can arise in the lungs and, in severe cases, can cause disability or even death due to respiratory compromise.

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At BNL, beryllium has had limited uses in reactors and accelerators. For this reason, handling and machining of beryllium metal and beryllium alloys has been very limited at BNL. In addition, in recent years, BNL has maintained very tight beryllium exposure controls, preventing significant worker exposure in tasks such as the installation of beryllium tubes in the RHIC detectors during construction in 1999-2000. Twelve current BNL employees have been identified by Industrial Hygiene as having had beryllium exposure in the past at BNL. These employees are classified as "Beryllium Associated Workers" according to the DOE Federal Regulation 10CFR850 *Chronic Beryllium Disease Prevention Program* (1999), and are offered beryllium medical surveillance every three years. This is directed at the detection of beryllium sensitization (through a special blood test called the BeLPT) and CBD through chest x-ray and spirometry.

A previous round of beryllium medical surveillance of 4 current and 16 former BNL employees in 2000-2001 yielded no instances of beryllium sensitization or CBD.

<u>Results</u>: Nine out of the twelve beryllium-associated workers consented to beryllium medical surveillance. (In accordance with the DOE Beryllium Standard, beryllium medical surveillance is considered voluntary.)

- **No cases of chronic beryllium disease (CBD) were identified.**

- **One employee, a technician at AD, was found to be sensitized to beryllium, based upon 2 abnormal BeLPT tests. Fortunately, he showed no signs of CBD.**

  The finding of Be sensitization in this employee was very unexpected, as this employee had very transient, apparently trivial exposures to beryllium during his 13 years of employment at BNL. These potential beryllium exposures consisted of: 1) Installing beryllium tubes into the RHIC detectors 1999-2000. This work involved no machining of the beryllium, which had been built to specification by the manufacturer. Wipe tests of the epoxy-coated tube exteriors and airborne monitoring during installation operations had been negative. 2) By the employee's recollection, he had worked at one time near an operation in which metal caps were welded onto the ends of beryllium tubes.

  Prior to coming to BNL, the worker had a 25-year career as an auto mechanic. Beryllium is found in certain automotive components, including electronic ignitions. Therefore, it is possible that sensitization to beryllium occurred as a result of exposures prior to the employee's work at BNL. The

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employee has since retired from BNL and will be followed by DOE's beryllium surveillance program for former workers.

Cadmium

Background

The heavy metal cadmium has been associated with lung and kidney toxicity and increased lung cancer risk. The major route of entry of concern is inhalation of airborne cadmium particulates. Parenthetically, cigarette smoke is a non-occupational source of cadmium internal dose.

At BNL, significant exposure to cadmium is rare. Certain types of shielding contain cadmium, so there is potential for cadmium exposure from cadmium-containing dusts from such shielding when it is stored or manipulated.

The OSHA Cadmium Construction Standard (29CFR1926.1127) requires initial cadmium medical surveillance, followed by a second round of cadmium surveillance one year after the initial round, even where exposure has ceased, because cadmium can have delayed biological effects.

Cadmium medical surveillance consists of obtaining blood and urine cadmium levels and comparing these results to OSHA biological exposure indices (BEI), which are threshold values for blood and urine tests. Exceedance of these thresholds indicates overexposure to cadmium. Urine beta-2 microglobulin is also checked; elevated levels suggest the possibility of kidney damage due to cadmium exposure, resulting in leakage of the small beta-2-microglobulin protein into the urine.

Cadmium monitoring results:

- **One employee from RP received an initial round of cadmium medical surveillance for current or recent cadmium exposure. Blood and urine cadmium concentrations were well within the acceptable range and beta-2-microglobulin testing detected no evidence of kidney damage.**
- **Two RP employees and two EP employees received a second round of cadmium medical surveillance, in accordance with the OSHA standard, for cadmium exposure which had ceased prior to 2005.**
    - **Blood and urine cadmium concentrations were well within the acceptable range and beta-2-microglobulin testing detected no evidence of kidney damage.**
    - **Chest x-ray results were normal, indicating no detectable adverse pulmonary effects from cadmium exposure.**

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Lead

Background

Lead can adversely affect a number of organ systems, including the neurological, renal (kidney) and hematological (bone marrow and blood) systems. Respiratory exposure to airborne lead particulates or metal fume is of the greatest concern. Ingestion during eating or smoking in the workplace is also a concern absent proper hand washing and hygiene.

At BNL, potential sources of lead exposure include: lead shielding—production of airborne particulates when the shielding is handled, cut or otherwise worked, especially if oxidized; lead dust at the firing range; removal or disturbance of old lead paint; and lead solder—less of a problem now since modern solders have reduced percentages of lead.

Most lead-exposed BNL employees receive medical surveillance under the OSHA Lead Construction Standard, 29CFR1926.62. Some fall under the OSHA Lead General Industry Standard 1910.1025. At a minimum, OSHA mandates that lead medical surveillance include a blood lead level (BLL) and red blood cell zinc protoporphyrin (ZPP). Additional examinations and testing are performed as indicated or mandated by OSHA. The BLL reflects recent lead exposure.

- A BLL of 40ug/dL or higher is considered to indicate lead overexposure and the possibility of organ toxicity. Work removal is mandated under both OSHA standards for a BLL at or above 40 ug/dL.
- ZPP is a hemoglobin precursor which builds up in red blood cells when hemoglobin production is inhibited by the presence of lead. ZPP may give some indication of lead exposure during the prior 4 months, since the average red blood cell remains in circulation for 4 months.
- At BLLs typically observed in BNL workers, ZPP is a poor measure of prior lead exposure because the test is very non-specific, and can be elevated for other reasons, including inhibition of hemoglobin production due to iron-deficiency anemia. For this reason, ZPP results are not reported here beyond the general statement that nearly all BNL FY05 ZPP results fell within the normal range. In the few instances where ZPP was found to be elevated, alternate medical reasons were found.

Medical Surveillance Results—OSHA Lead Construction Standard

A total of 101 employees received 103 blood lead tests under the OSHA Lead Construction Standard (one employee received three tests in FY05). Most employees (94) worked for EP.

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The overall median blood lead level (BLL) was 2.9 ug/dL and there was little variation between the different divisions/depts: EP-2.9, HP-1.5, LS-1.7, and SC—3.6 ug/dL, respectively.

The range of BLL's was from <1 ug/dL to 8.8 ug/dL, except for one outlier, an LS employee with a BLL of 30.6 ug/dL. It was subsequently established that this employee had non-occupational lead exposure associated with a hobby. Two LS co-workers engaged in similar work had BLL's of 1.4 and 1.7 ug/dL, further indicating that the employee's major exposure was non-occupational. In subsequent BLL testing, the employee's BLL declined from 30.6 to 21.9 ug/dL over a 4 month period.

Medical Surveillance Results—OSHA Lead General Industry Standard

A total of 23 employees had blood lead monitoring under the OSHA Lead General Industry standard. Median blood lead level (BLL) was 3.2 ug/dL, with little variation among divisions/departments-- AD-3.9, DE—2.1, EP-3.4, HP-1.3, RP-3.2, SC-3.3, SE-3.3, and WM-3.0 ug/dL.

The range of BLL's was <1 ug/dL to 5.8 ug/dL, with one outlier, a WM employee with a BLL of 11.2 ug/dL. This employee had a hobby associated with non-occupational lead exposure. This employee's WM co-workers had BLL's that ranged between <1 and 3.9 ug/dL, providing further evidence that this employee's predominant lead exposure was non-occupational.

Noise

Background

A worker with occupational noise exposure at or above the OSHA Action Level is required to undergo audiometric testing (hearing tests) on an annual basis, for the early detection of noise-induced hearing loss. The worker's initial test under the OSHA Occupational Noise Standard (29CFR1910.95) serves as a baseline. Occupational hearing loss detected in subsequent years and meeting or exceeding a threshold ($\geq$ 10 decibels [dBA] averaged over 2, 3 and 4 kHz in either ear) is referred to as a "Standard Threshold Shift" ("STS") and must be recorded by the employer on the OSHA 300 Log.

Noise Medical Surveillance Results

OMC performed 359 OSHA hearing tests on 355 BNL employees in FY05 (4 employees had 2 exams each). Just 1 OSHA recordable case of occupational hearing loss (or "STS") was detected. This represented a marked improvement from CY04, when 7 such STS's were detected.

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The one employee with a work-related STS in FY05 was a carpenter in Plant Engineering who has been employed at BNL since 1993.

Summary and Discussion

- Medical surveillance results indicate that work planning and exposure control measures have been highly successful at protecting BNL workers from workplace health hazards and from adverse health effects from these hazards.

- No occupational overexposures or adverse health effects were found for asbestos, cadmium or lead. Blood lead levels (BLLs) remain low, and are not significantly different from those recorded in CY04, or from values recorded in the general adult population (see table below). The average (median) BLL was slightly higher in FY05 than in CY04 (3.0 vs. 2.6 ug/dL), but among 42 employees who had lead medical surveillance in both years, there was, on average, a change of 0 ug/dL in their BLLs, suggesting no significant trend in lead exposure.

Comparison of BNL BLLs to general (working age) population:[1]

Group	**Avg. BLL (ug/dL)**
BNL employees monitored in 2004	2.6
BNL employees monitored in 2005	3.0
General pop. age 20-49	2.1
General pop. age 50-69	3.1

- Only one employee had a BLL anywhere near the OSHA threshold of 40 ug/dL that triggers work removal. That employee, who had a BLL of 30.6 ug/dL, was found to have a hobby associated with lead exposure. His BLL declined after he curtailed the hobby.

- Beryllium surveillance detected beryllium sensitization in one AD technician. As noted above, a causal relation between BNL exposures and sensitization appears unlikely in this employee, considering his transient, extremely low-level beryllium exposures at BNL, and his prior long-term employment at a job with potential beryllium exposure. Fortunately, this employee, now retired, showed no evidence of chronic beryllium disease, and will continue to be monitored under DOE's former worker medical surveillance program.

[1] Updated Blood Lead Levels – United States 1991-1994. MMWR Weekly 46(7):141-146. 1997.

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Recommendations

- Continued workplace exposure monitoring, appropriate exposure control measures, and medical surveillance in accordance with applicable OSHA and DOE standards, and best practices.

- Continued medical surveillance of workers with potential beryllium exposure to rule out beryllium sensitization and chronic beryllium disease, considered highly unlikely given the very limited, infrequent beryllium exposures at BNL.

- Continued efforts at controlling noise exposure at BNL. Great progress has been made in this area, as evidenced by the remarkable decline in the number of Standard Threshold Shifts (OSHA-recordable noise-induced hearing loss) between CY04 and FY05.

- Encouraging employees to bring their safe work practices with them when they work or engage in hobbies outside of BNL. As noted, both employees with atypically high blood lead levels had lead exposures traceable to hobbies—shooting at a firing range and making homemade bullets.

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